GB2033632

Publication Title:

Touch-sensitive switch units

Abstract:

Abstract of GB2033632

A touch sensitive switch unit, e.g. for use in an air traffic control system, includes a matrix of touch sensitive regions provided at the intersections of two orthogonal sets of conductors 103, 107. One set is supported by a flexible sheet so that intersecting conductors may be brought into contact in response to touch. Computer 117 controls units 111, 113 to scan the rows and columns. The sensed data controls a display. With close-spaced conductors a cluster of contacts may be formed. Here the computer 117 is programmed to determine the cluster centroid. Finger pads, or ball-bearings in holes (under a flexible retaining sheet), may be used to press the conductors together.

(12) UK Patent Application (19) GB (11) 2 033 632 A

(21) Application No **7931947**
(22) Date of filing **14 Sep 1979**
(30) Priority data
(31) **78/37866**
(32) **22 Sep 1978**
(33) **United Kingdom (GB)**
(43) Application published
21 May 1980
(51) **INT CL**^{3}
G06F 3/00
(52) Domestic classification
G4H 13D 14B 14D KS
H1N 443 45X 616 618 626 700 704
(56) Documents cited
GB 1508502
GB 1499927
GB 1464912
GB 1429682
GB 1426602
GB 1407248
GB 1405498
GB 1385902
GB 1380282
GB 1339223
GB 1248382
(58) Field of search
G4H
(71) Applicants
The Secretary of State for Defence,
Whitehall,
London SW1A 2HB.
(72) Inventors
Robert Frank Bateman,
Thomas Clifford Butler,
Alan Victor Mathews,
Edwin Thomas Wilkinson.
(74) Agents
J. B. Edwards

(54) **Touch-sensitive switch units**

(57) A touch sensitive switch unit, e.g. for use in an air traffic control system, includes a matrix of touch sensitive regions provided at the intersections of two orthogonal sets of conductors 103, 107. One set is supported by a flexible sheet so that intersecting conductors may be brought into contact in response to touch. Computer 117 controls units 111, 113 to scan the rows and columns. The sensed data controls a display. With close-spaced conductors a cluster of contacts may be formed. Here the computer 117 is programmed to determine the cluster centroid. Finger pads, or ball-bearings in holes (under a flexible retaining sheet), may be used to press the conductors together.

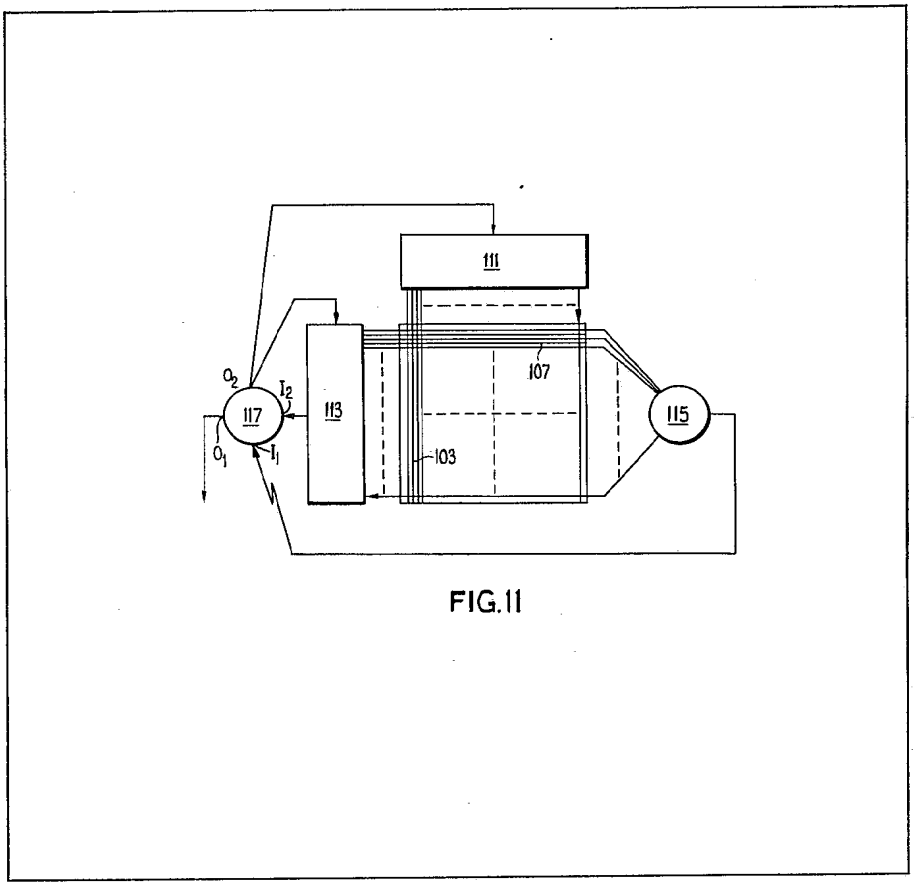

FIG.11

GB 2 033 632 A

2033632

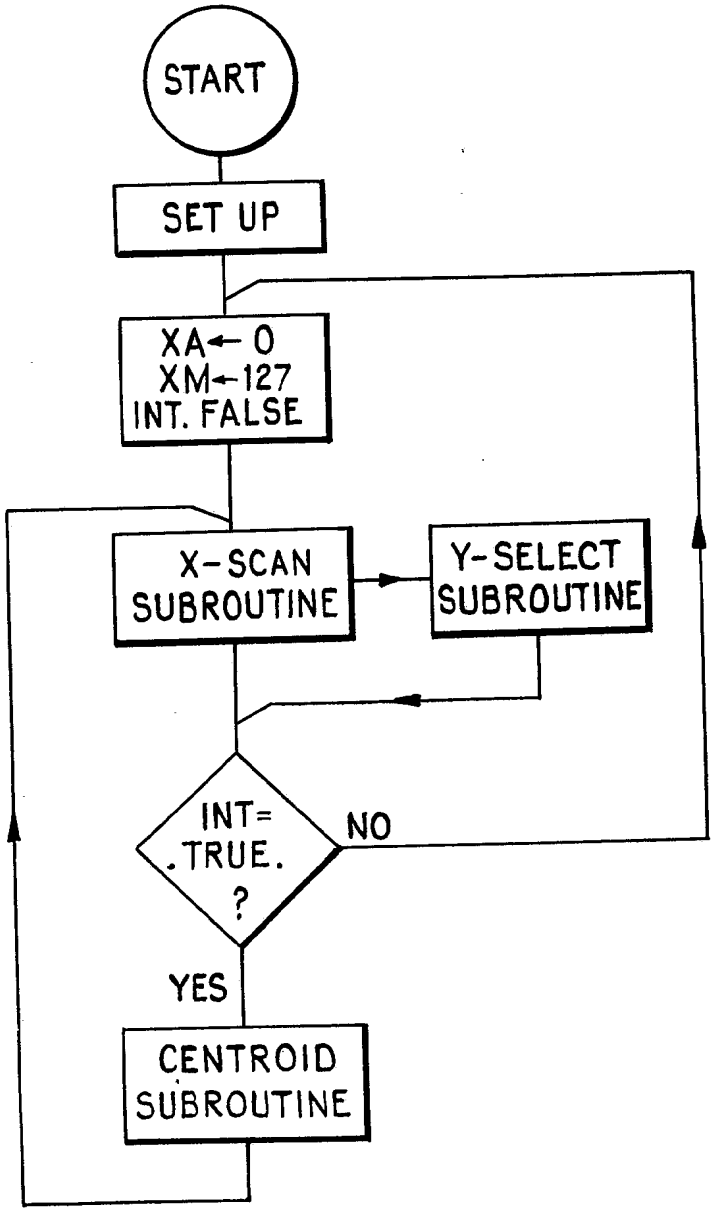

FIG.1

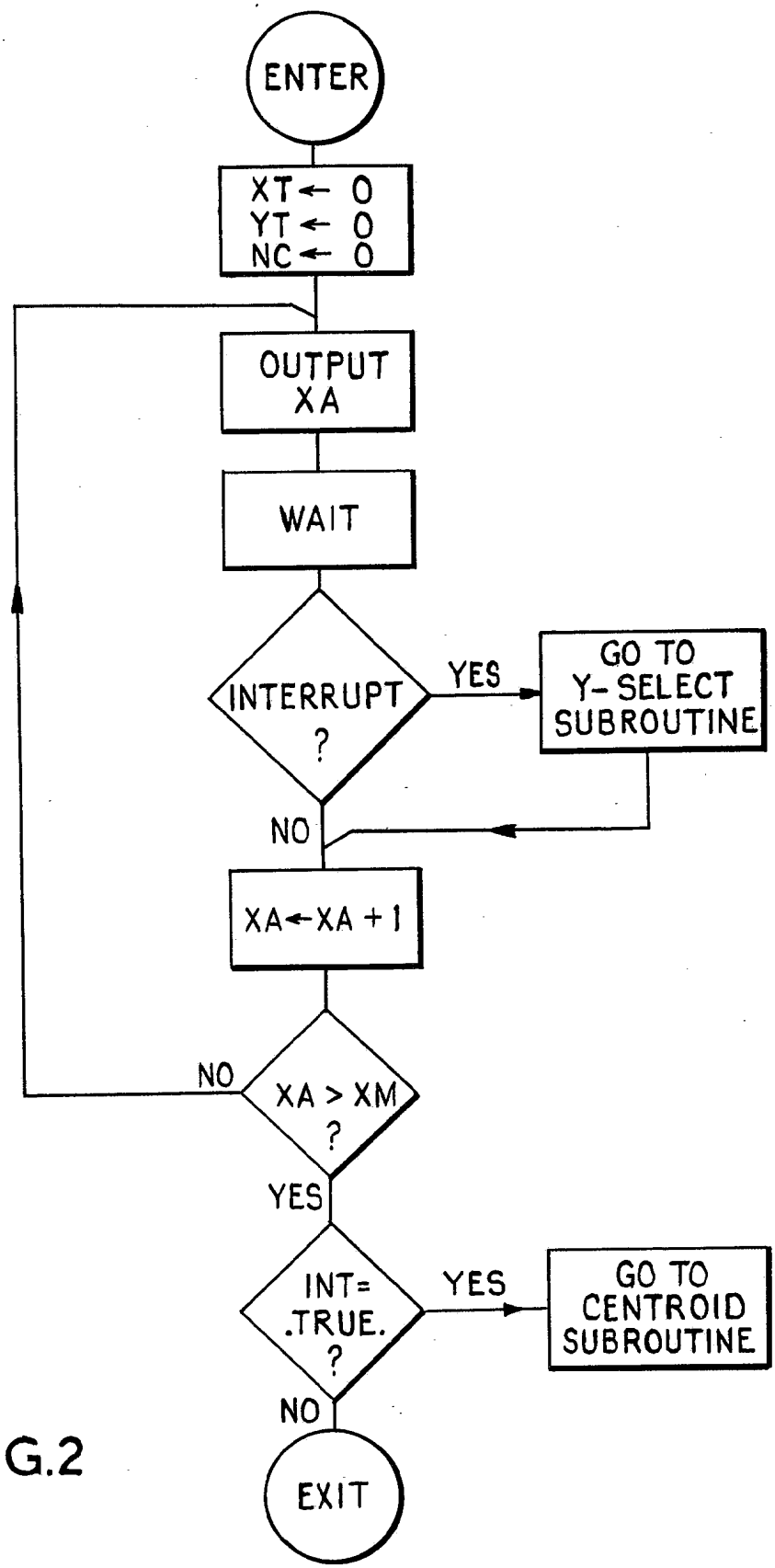

FIG.2

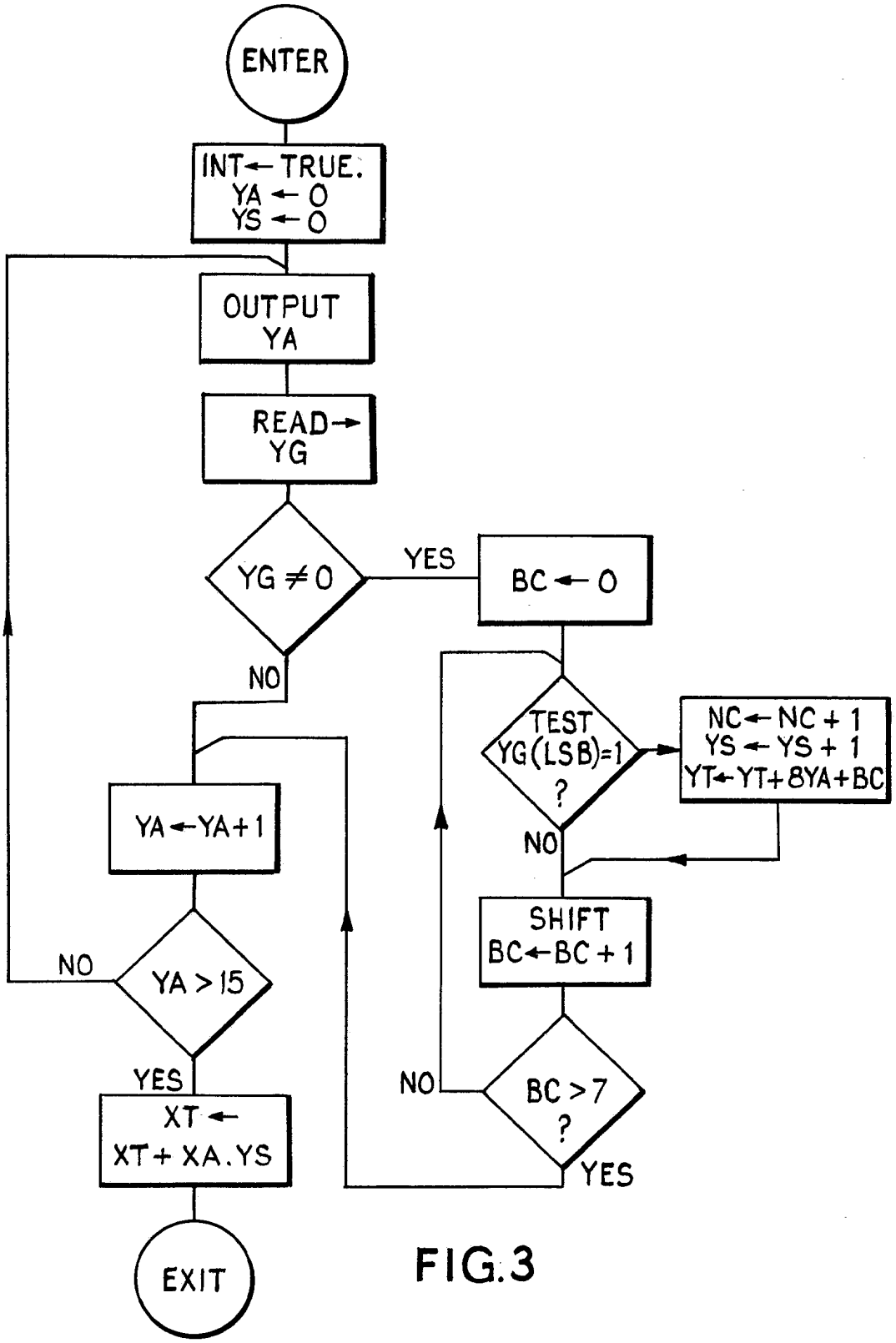

FIG.3

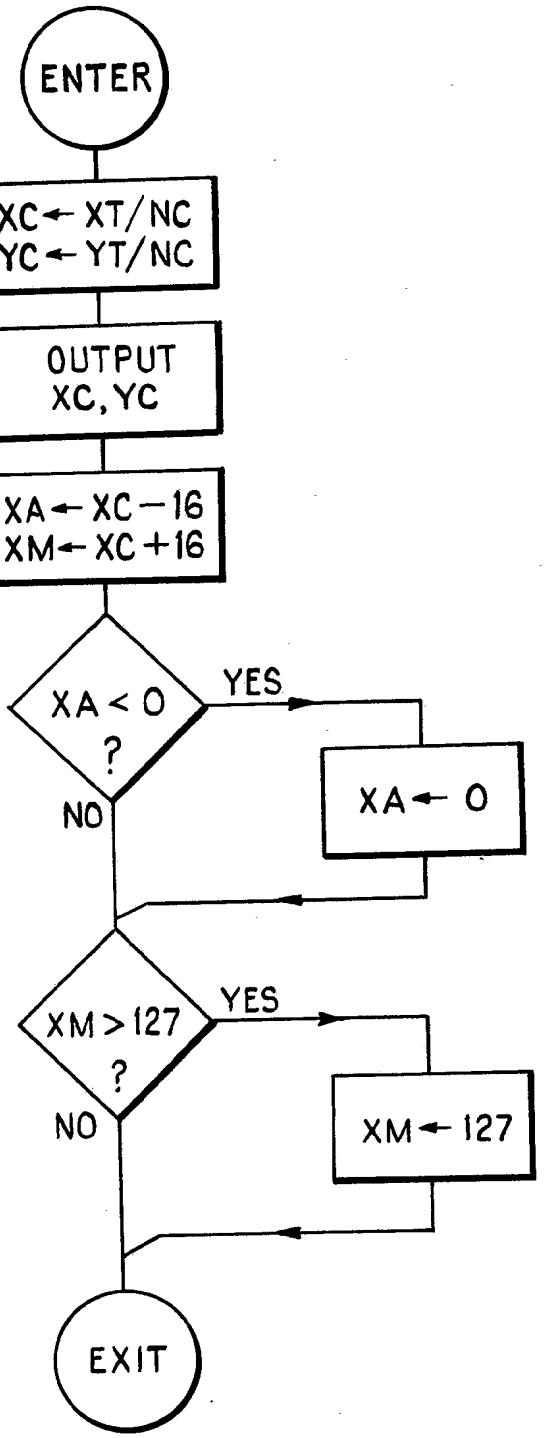

FIG.4

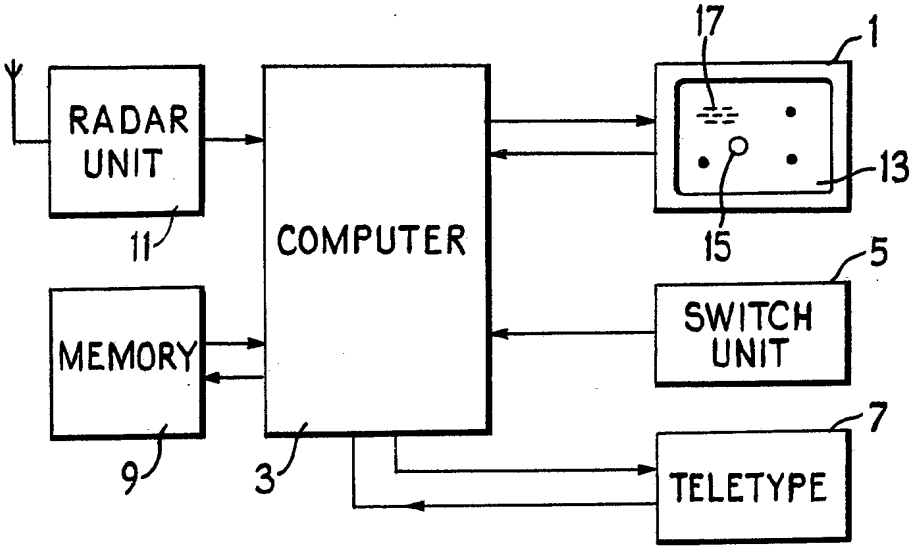

FIG.5

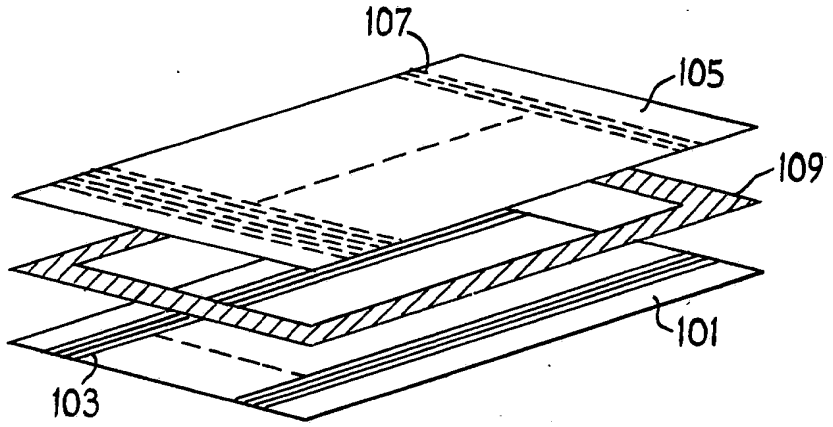

FIG.10

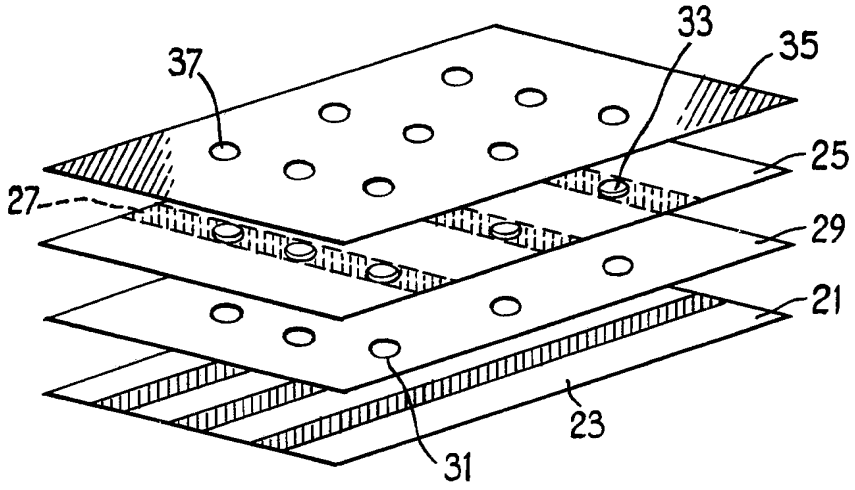

FIG.6

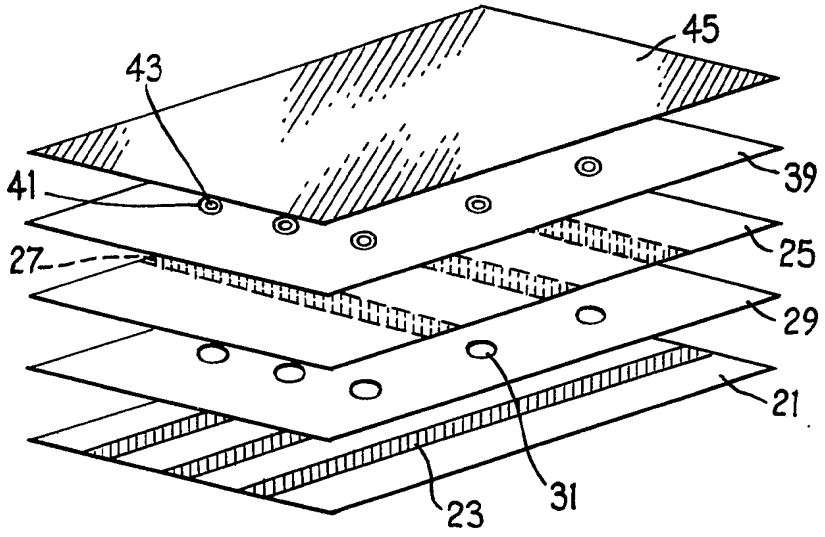

FIG.7

2033632

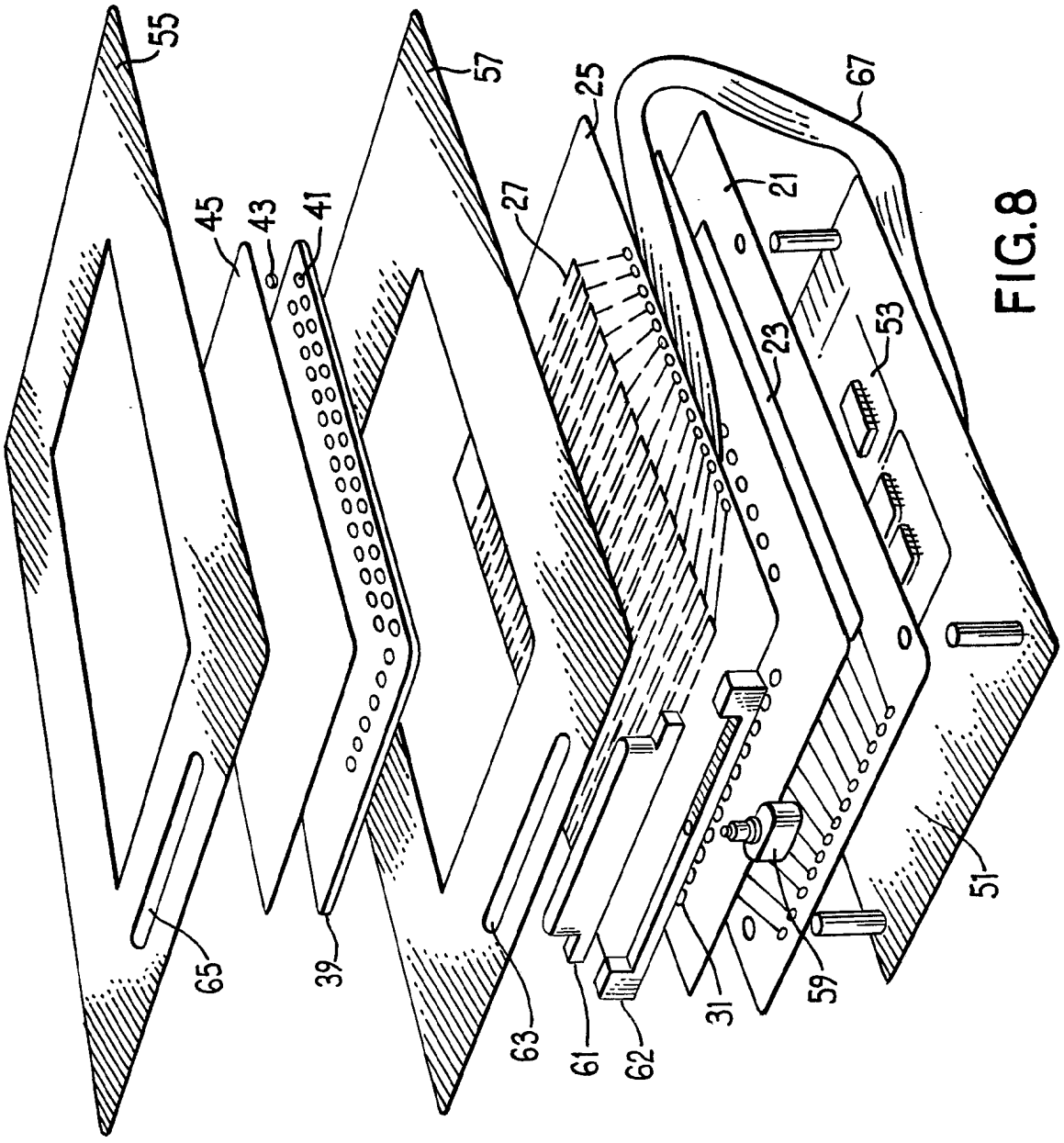

FIG.8

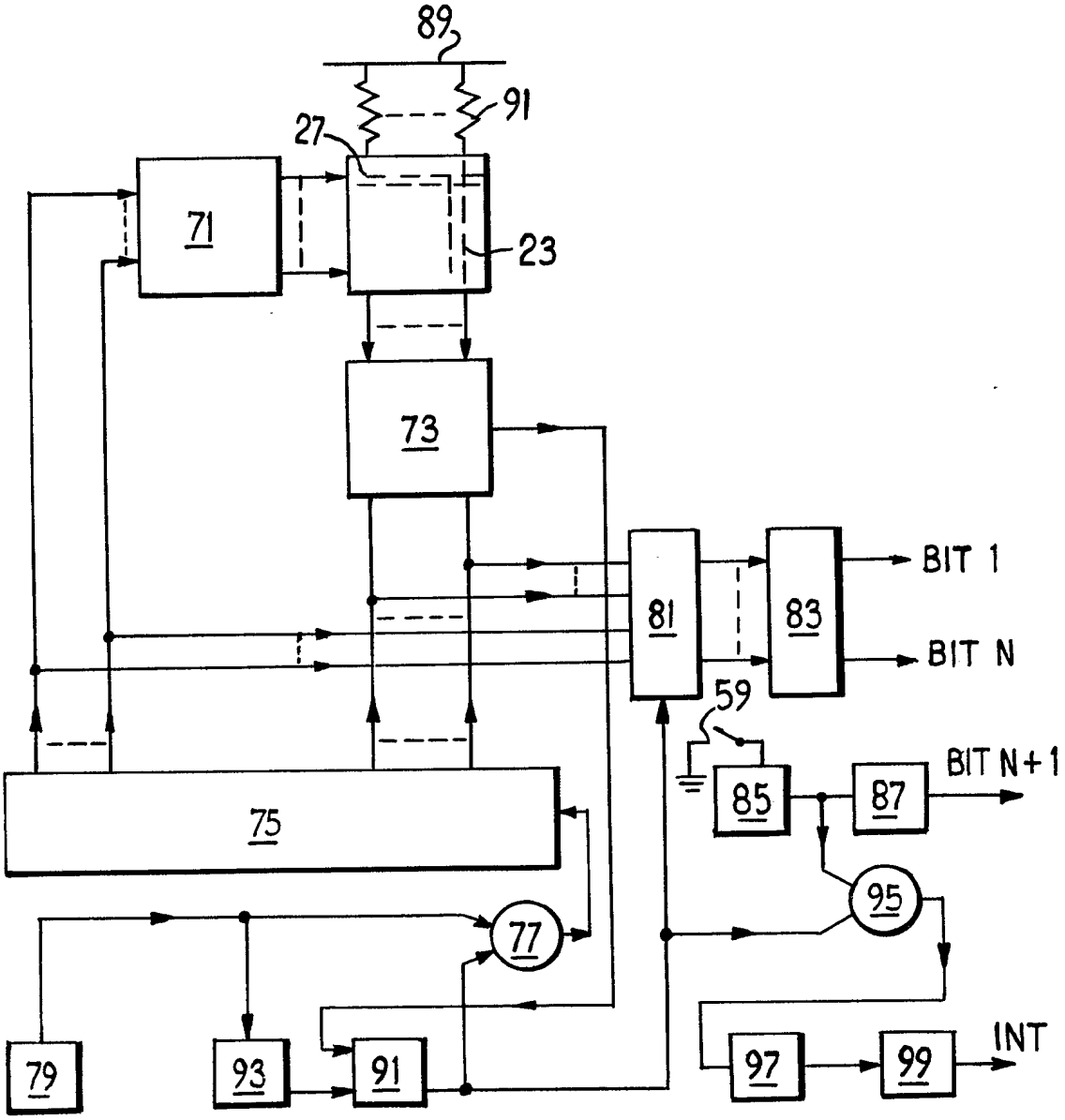

FIG. 9

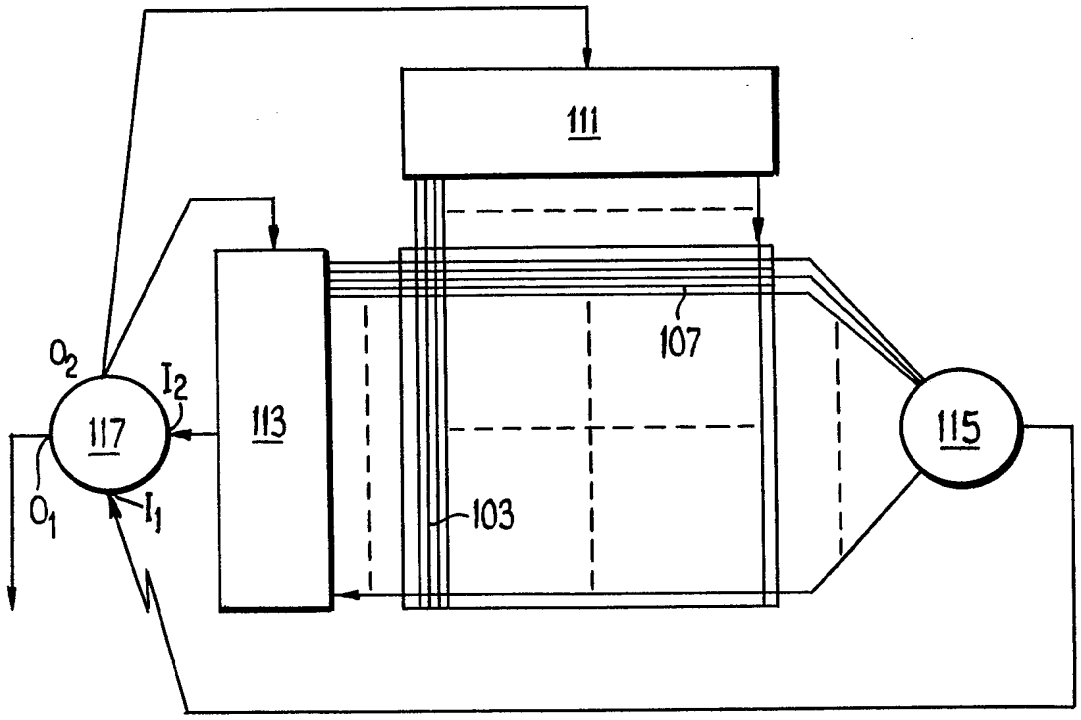

FIG.11

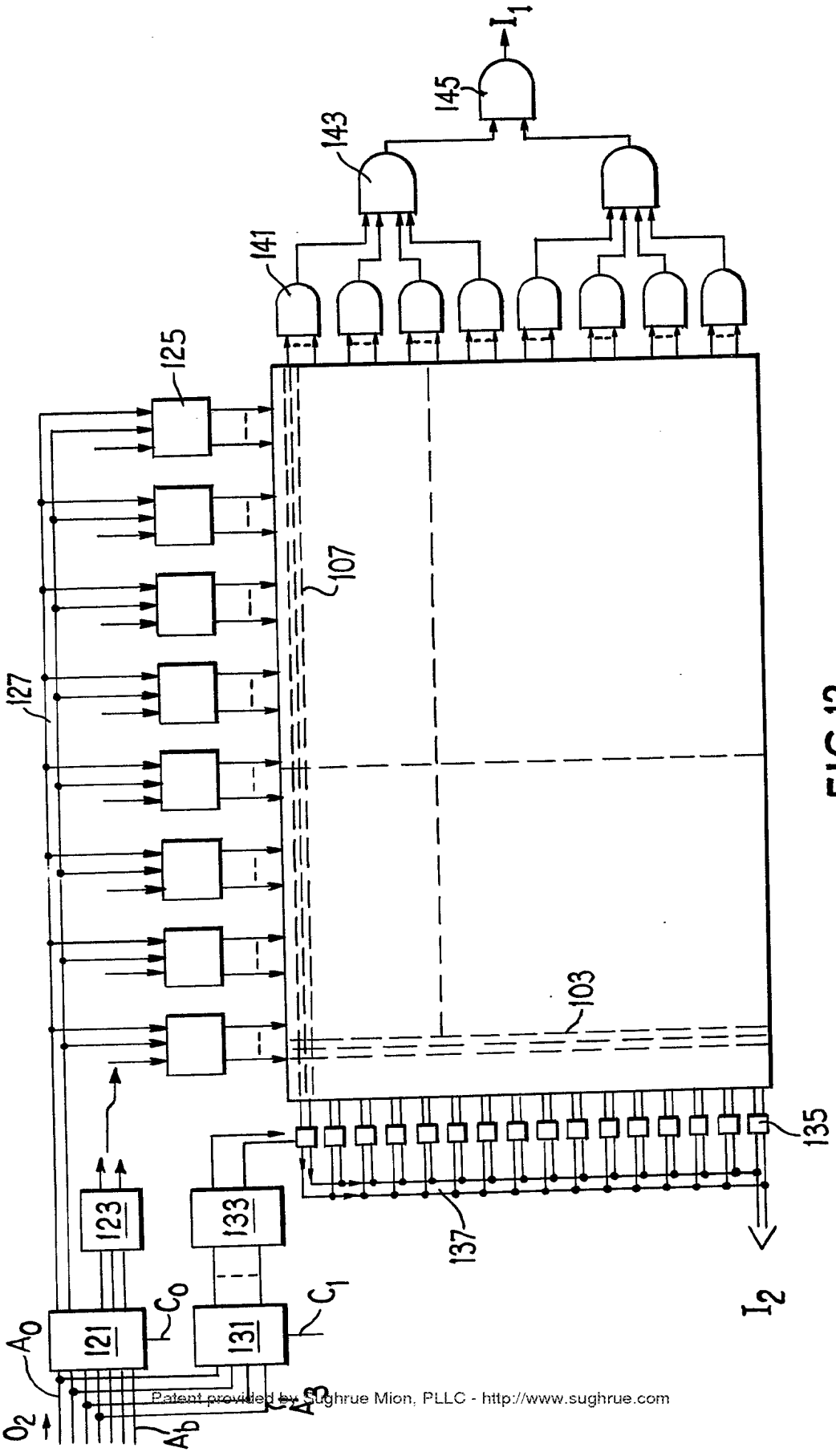

FIG.12

SPECIFICATION

Touch sensitive switch units

This invention concerns touch sensitive switch units particularly switch units for interactive display systems.

Typically an interactive display system comprises a display unit, a programmed computer controlling the information displayed on the display unit and a switch unit co-operative with the computer and video display unit, by which means an operator may control the features displayed.

In air traffic control, for example, the computer receives information in the form of data from a radar unit, and a radar scene is depicted on the screen of the display unit. The operator, by manipulating the switch unit, can control the movement of an illuminated indicator so that it moves across the screen towards a selected position and in this way, by instructing the computer he can summon aircraft labelling/identifier information to identify an aircraft at or near the selected position. Alternatively the switch unit may be used to summon enlarged detail display of a selected area shown initially on the screen in less detail. The switch unit is also used for "menu selection".

Interactive display systems may also be used in computer program development, eg for computer aided design. For example, a circuit board print may be designed by using such a system, calling up a number of standard component design subprograms using menu selection, and relating them to screen co-ordinates. Design blocks and sub-features may be altered by operator interaction, before the design is finalised.

There are several known forms of switch unit used in existing systems. In one form the unit is integral with the screen. It may include a number of paired wires defining a co-ordinate grid on the screen, (See, for example, UK Patent No 1,172,222). By pointing to features on the screen and bridging these pairs, the operator may trip detector circuits co-operative with the wires and so afford co-ordinate identification of the features selected. An alternative switch unit is also described in Control Engineering July 1976 pp 33-34. Here a screen mounted panel is provided containing a wire matrix defining a multiplicity of separate touch points. However, it is a problem of this unit that wires break at points of matrix intersection. Similarly, intersecting beams of infra-red light have been used to define a screen detection grid, interruption of the beams affording co-ordinate identification. However, though the response of these systems is quick, the operator has to reach out to the screen each time he wishes to select a feature, and in turn this leads to operator fatigue. In another form, the switch control unit is remote from the screen. A particular example of this form of unit is the rolling ball potentiometer control. The operator, by rotating the ball, may control the movement of an indicator across the display screen in the X and Y co-ordinate directions. However, though this form of switch control unit is less fatiguing, the inertia of the ball introduces a time delay when features spaced across the screen are alternately selected; the response is therefore somewhat slower.

There is a need for a switch unit that is quick in responding to operator selection, that is not fatiguing when used, and that is relatively inexpensive to produce.

According to the present invention there is provided a touch sensitive switch unit for use in an interactive display system, the unit being constructed as a module and comprising:-

a switch pad having a first set of spaced strip conductors formed upon

a sheet of rigid material,

a second set of spaced strip conductors formed upon a sheet of flexible material and arranged to face the first set of conductors,

a spacer between the two sheets, and,

a pad mounting assembly arranged to hold the sheets about their periphery with the two sets of conductors arranged and separated to provide a matrix of touch addressable contact regions;

address means connected to one set of conductors to supply an address voltage to each conductor in sequence;

detector means, connected to the other set of conductors, constructed to select each conductor in sequence and to detect any change in the voltage state of a selected conductor when contact is made between selected conductor and an addressed conductor;

control means co-operative with both the address means and the detector means, to synchronise the operation thereof in a scan sequential manner; and

data supply means co-operative with both the control means and the detector means to provide co-ordinate data identifying the matrix position of any detected contact.

Conveniently, the switch unit, being in the form of a module, as distinct from a screen overlay, can be positioned in front of an operator so that he may use it without undue strain. It may also be arranged that the switch unit interacts with not only one display unit but with several during system operation - for example switch operation for one display unit may be transferred for another, under teletype command, or by menu selection with reference to a central display unit.

In one form of the invention, the conductors may be wide-spaced so that when finger pressure is applied to the flexible sheet, only one conductor is urged into contact with another. Preferably, in this form of the invention, the two sets of conductors may be separated by a sheet spacer of insulating material, this sheet having a plurality of holes, each hole in register with a corresponding one of the addressable contact regions. Conveniently in this form of the invention, the switch pad may also include a ball-bearing assembly comprising: a rigid mask, having an array of retaining holes, and arranged adjacent to the flexible sheet with each retaining hole in register with the addressable contact regions; a plurality of ball bearings, one in each hole; and, overlying the mask and ball bearings, a retaining sheet of flexible material.

In an alternative form of the invention, the conduc-

tors may be close-spaced so that when finger pressure is applied to the flexible sheet, a cluster of contacts is formed between the two sets of conductors.

The invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figures 1 to *4* are flow charts illustrating a programme governing switch unit control,

Figure 5: is a schematic illustration of an interactive display system,

Figures 6 and *7* are illustrative exploded views of alternative switch pads,

Figure 8: is an exploded view of a switch unit including the switch pad of Figure 7 above,

Figure 9: is a block circuit diagram for the switch unit of Figure 8,

Figure 10: is an exploded view of an alternative switch pad,

Figure 11: is a block diagram of the switch unit including the switch pad shown in Figure 10, and

Figure 12: is a more detailed diagram of the switch unit shown in Figure 11.

An interactive display system is shown in Figure 5, and comprises a visual display unit 1, a central computer 3, and a switch unit 5. The computer 3 is also connected to a teletype 7 and a memory store 9. Program and simulated radar data may be stored in the memory 9, or alternatively actual radar data may be input to the computer by means of a radar unit 11. In either of the examples, the operator instructs the computer via the teletype 7 and calls up a radar scene on a screen 13 of the display unit. The computer 3 is programmed so that as the operator manipulates the switch unit 5, an indicator 15 is moved in response across the screen. The operator controls the movement of the indicator 15 so that it is moved to a selected position near a target that he wishes to identify and, on command, the computer generates labelling information 17 which is displayed on the screen 13.

The construction of a switch pad for the switch unit 5 is shown in the exploded view of Figure 6. The pad here comprises a base board 21 of rigid material eg fibreglass having defined on its upper surface a plurality of strip conductors eg of gold plated copper, forming an array with each conductor 23 extending in the Y- direction of the X-Y horizontal plane. Lying above the base board 21 is a thin sheet 25 of flexible material, eg Captan (... Trade Mark) or Mylar (....Trade Mark), having printed on its undersurface a plurality of strip conductors, here forming an array with each conductor 27 extending in the X-direction of the X-Y plane. Sandwiched between the base board 21 and the sheet 25 is a spacer sheet 29 of insulating material eg Mylar (.... Trade Mark), this sheet 25 being provided with a plurality of holes, each hole 31 corresponding to an intersection of the crossed conductors 23, 27. The thicknesses of the sheets 25, and 29 are chosen so that each one of the conductors 27 may be urged resiliently into electrical contact with a corresponding conductor 23 when light finger pressure is applied at the position of each intersection. On the upper surface of sheet 25 is an array of finger pads, each pad 33 corresponding to an intersection and defining a switch position. A mounting plate 35 of rigid material eg aluminium sheet, is mounted above sheet 25 and has a plurality of holes 37 through which the pads 33 project.

Alternatively, as shown in Figure 7, the pads 33 and plate 35 may be replaced by a ball bearing assembly. Here, a rigid mask 39 is provided with an array of retaining holes 41, each hole corresponding to a collocation when the mask 39 is mounted and registered with sheet 25. Switch positions are defined by means of ball bearings 43 which fit loosely in holes 41 and are held in position by a retaining sheet 45 of flexible material. A finger may be lightly run over the surface of the retaining sheet 45 to apply light pressure to any one of the ball bearings and thus to urge one of the conductors 23. In this case when the switch pad is used, as in the switch control unit 5 of Figure 5, the operator may cause data on the display screen 13 to change whilst at the same time he is concentrating on the display, and, without having need to glance at the switch pad.

Conveniently the switch pad may be combined with address logic in a single intergrated unit. Thus in the switch unit shown in Figure 8 the components (21,25,29,39,43,45) of the switch pad shown are combined with a circuit layout of address logic components 53. The sheet 45 and mask 41 are held in position by means of metal frames 55,57 and an "ACCEPT" button is provided by a switch 59, co-operative with a plastics tab 61 through apertures 63,65 in the frames 57,55. The conductors 23,27 are connected to the logic components 53 by means of wires 67.

The address logic is depicted in Figure 9. the conductors 27 are each connected to a separate output of a line decoder 71, and the conductors 23 are connected each to one of a corresponding number of inputs of a data selector 73. Both the line decoder 71 and the data selector 73 are controlled by a binary counter 75. This counter is clocked via a logic gate 77 by an oscillator clock 79, and the outputs of the counter are also gated to data output lines Bit 1,.... Bit N via a logic gate array 81 and buffer array 83. The accept switch 59 is connected via a latch 85 and buffer inverter 87 to an additional data output line, Bit N + 1. Each of the conductors 23 is connected to a common voltage line 89 via a corresponding resistor 91. Whilst all conductors 23 and 27 remain out of contact with each other, no current can flow through the resistors 91 and the conductors 23 are all held at the voltage of the line 89.

The data selector 73 has an output connected to one of the inputs of a retriggerable monostable 91. The other input of monostable 91 is connected to the clock 79 via a monostable 93. The inverting output of the retriggerable monostable 91 is connected to both an input of the clock gate 77 and an input of the gate array 81. This output, as also the output of the latch 85 are connected to OR gate 95 to provide via an additional monostable 97 and buffer invertor 99, an INTERRUPT signal. The data outputs Bits 1 to N + 1 and the output of buffer invertor 99 are connected to the data input of the computer 3.

In operation, the clock 79 increments the binary

counter 75, so that each one of the conductors 27 may be addressed in turn. At each turn the addressed conductor is held low whilst the remaining conductors stay high. When one of the conductors 27 is urged into electrical contact with one of the conductors 23, the corresponding input to data selector 73 swings low as the selected conductor 27 is addressed. The output of data selector 73 swings high in response, when the appropriate conductor 23 is selected, and trips the retriggerable monostable 91. As this monostable 91 is tripped, gate 77 is shut and stops the clocking of the counter 75. The gate array 81 is also triggered so that the binary address from the counter is passed via the buffer array 83 onto the data output lines - Bits 1 to N. As address data is passed, an interrupt signal is also generated via OR gate 95, monostable 97 and buffer invertor 99. When later, finger pressure on the pad switch is removed, the output from the data selector 73 swings low and after a short delay the clock is restored to the binary counter 75 and the pad switch scanning cycle continued. Meanwhile, in response to the passed address, the computer 3 controls the display unit 1 in conventional manner so that an indicator 15 is displayed on the screen 13 in a corresponding selected position. By manipulating the pad switch, the operator moves the indicator 15 near to a selected target, and when the target is reached the operator presses the accept switch 59. Subsequently an address is passed along data output line Bit N + 1 to the computer 3 and labelling information displayed on the screen 13 of the VDU1.

Typically, the pad switch comprises 16 rows (X conductors 27) by 16 columns (Y conductors 23), the binary counter 75 has 8 Bits, the last four of the eight consecutive bit outputs of the counter 75 are connected to the line decoder 71, the first four outputs are connected to the data selector 73, conveniently the clock oscillator runs at approximately 8 kHz, the pad switch being scanned approximately every 30 msec.

In the above example the conductors are spaced so that during operation, only a single pair of conductors 23,27 is shorted together where finger pressure is applied. However, where high resolution is demanded, for example, to allow separate identification of closely approaching targets on the screen 13, alternative switch construction and address techniques are more appropriate.

Such an alternative switch construction is shown in Figure 10. The pad comprises a base board 101 of rigid insulation material, eg fibre-glass, having on its upper surface a multiplicity of closed spaced strip conductors, eg of gold plated copper, forming an array with each conductor 103 extending in the X-direction of X-Y horizontal plane. Lying above the base board 101 is a thin sheet 105 of flexible material, eg Mylar (.... Trade Mark) having printed on its undersurface a multiplicity of similar close spaced strip conductors, forming an array with each conductor 107 extending in the X-Y plane. Sandwiched between the base board 101 and the sheet 105 is a thin frame 109 of insulating material. The base board 101, frame 109, and sheet 105 are clamped together between an underplate and a rigid recessed frame (not shown). The thin frame 109 is of sufficient thickness to isolate conductors 103 from conductors 107. Preferably the material of frame 109 is bent out of the plane of the frame along the inner edges, so that when the pad is assembled, the periphery of sheet 105 is resiliently urged against the recess of the rigid recessed frame. This resilient action assists to maintain sufficient tautness of the flexible sheet 105, and, to maintain separation of conductors 103 and 107. Conductors 103, 107, respectively, are sufficiently close-spaced that a cluster of contacts between conductors 103 and 107 is made when light finger pressure is applied to the upper surface of the flexible sheet 105. Alternatively the sheet of flexible material 105 and the sheet of rigid material 101 may be sealed to contain gas, or gas-flow may be introduced between these sheets. The overpressure of gas in each case assists to separate the sheets and maintain the conductors 103, 107 out of contact.

The switch pad is incorporated in a switch unit as shown in Figure 11. Here the X-conductors 103 are each connected to the corresponding outputs of a line address unit 111, the Y-conductors 107 are connected each to a corresponding input of a selection unit 113, and the remote ends of the conductors are each tied to a high level d.c. voltage line via a resistor (not shown). A selection of the conductors 107 (eg alternate lines only) are also connected to a multiple input OR gate 115. The output of the OR gate 115 is connected to an input I1 of a microprocessor 117. This microprocessor 117 is provided to control the address and selection of conductors 103, 107 respectively, and to provide averaged cluster co-ordinates at a data output 0_1. An address output 0_2 of the microprocessor 117 is connected to the inputs of the line address unit 111 and the selection unit 113. An output of the selection unit 113 is connected to a data input I_2 of the micro-processor 117.

The microprocessor 117 is programmed so that in operation as it controls the line address unit 111 the X-line conductors 103 are addressed sequentially, one at a time. The addressed X-line in each case is driven to a low voltage level, whilst all neighbouring X-line conductors 103 are held at a high voltage level. When light finger pressure is applied in close proximity to the addressed X-line, the contact made between this X-line and one or more neighbouring Y-lines, the contacted lines are driven low and current drawing through the terminal resistors. As the Y-lines are driven low, the changed state of the lines is detected by the OR gate 115 and an interrupt pulse is generated at its output and fed to the output I1 of microprocessor 117. The X-scan cycle is then interrupted as the microprocessor 117 switches control to selection unit 113. This unit is then controlled so that the Y-line conductors 107 are gated in accessive groups to the input I2 of the microprocessor 117. Once all the Y-line groups have been gated, control is switched to unit 111 and the next X-line addressed. If an interrupt signal is generated by OR gate 115, control is again switched to the selection unit 113. The selection cycle is then repeated, for each X-line addressed, until no interrupt signal is generated. The microprocessor 117

processes the data received at input I2 and determines the co-ordinates of the contact cluster centroid. These co-ordinates are then output by microprocessor 117 to the main computer.

The switch control unit, just described, is shown in more detail in Figure 12 for a switch pad having 128 rows (Y-conductors 107) and 128 columns (X-conductors 103). The line address unit 111 comprises an address input gate unit 121, a first control decoder 123 and eight address decoders 125. The input gate unit 121 has 7 address inputs A_0, A_1 ..... A_6 and a control input Co, connected to the 8-bit output 02 of the microprocessor 117. A signal on control input Co controls gating of an address signal on inputs A_0 to A_6, the address on inputs A_0 to A_3 being gated onto a 4-bit highway 127, the address on inputs A_4 to A_6 being gated to the three inputs of control decoder 123. This control decoder 123 has eight outputs, one connected to each of the eight address decoders 125 for controlling the gating of each decoder in turn. Each address decoder 125 is also connected to the 4-bit highway 127 and controls the address applied to each one of a corresponding group of 16 of the 128 X-conductors 103. The selection unit 113 comprises a selection input gate unit 131, a selection decoder 133 and 16 tri-state buffers 135. The selection input gate unit 131 has four address inputs A'_0 to A'_3, connected in parallel to inputs A_0 to A_3, and a control input C_1. Control input C_1 is connected to the 8th bit of the output 02 of the microprocessor 117, it being arranged that the input gate units 121, 131 operate alternately as the 8th bit address changes, control switching from one to the other accordingly. The selection decoder 133 has four inputs connected to the gated outputs of the input gate unit 131, and sixteen outputs, one to each of the sixteen buffers 135.

The buffers 135 are each connected to a different group of eight of the one hundred and twenty eight Y-conductors 107 and feed in parallel an 8-bit highway 137 which conveys selected data to the data input I_2 of the microprocessor 117.

The OR gate unit 115 comprises a pyramid array of OR gates, having a set of eight 8-input gates 141, two 4-input gates 143 and one 2-input gate 145. The sixty-four inputs of the set of gates 141 are connected to alternate conductors 107. The output of gate 145 is connected to the interrupt input I_1 of microprocessor 117.

The microprocessor 117 is programmed to perform the functions of controlling line address and line selection, determining the several co-ordinates of a contact cluster, and averaging data to provide centroid co-ordinates for the main computer 3. The programme is written into the ROM memory store of microprocessor 117 and is defined by the flow charts outlined below:-

The main programme

FLOW CHART (1) - Figure 1

After the programme is started and after initial set-up, the X-scan limits are set, an X-word address XA is set to an initial value zero, and the maximum value to which it will run is limited by a variable XM set to 127. This enables an initial full scan of all 128 X-lines. An interrupt flag is set with initial state .FALSE. Control proceeds to the execution of an X-scan subroutine. If during the execution of the subroutine an interrupt occurs, the state of the flag INT is changed to .TRUE. and control shifts to and from a Y-selection routine. After the X-scan subrountine has been executed, the state of the interrupt flag is tested. If still .FALSE. the main programme is re-executed. If .TRUE., however, control proceeds to a centroid subroutine, cluster centroid data is generated and control transferred to the X-scan routine for execution, and for performance of a successive and limited X-scan.

The X-scan subroutine

FLOW CHART (2) - Figure 2

During the execution of the subroutine successive address word signals are sent to the address input gate to enable controlled and sequential address of the X-conductors. On entering the subroutine X and Y co-ordinate summation variables XT, YT are set to zero for the start of a scanning cycle. A counter variable NC is also set to zero. Once these variables have been set, the X-address word, an $\frac{3}{4}$-bit word XA, is repeated to the address output 0_2 of the microprocessor 117, the 8th bit being coded to identify the word address signal as an X-address so that the input gate 121 may be switched to gate the final seven bits, the four least significant bits on to the 4 bit highway and the three most significant bits to the three inputs of the address decoder 123. In response the first X-line is switched low. The microprocessor 117 then waits, typically for a pause of 3 μsecs to allow for any interrupt signal that may be generated by OR gate unit 115. If no interrupt signal occurs during this pause, the X-word address XA incremented and control proceeds to output this next XA address. The second X-line and thereafter third, fourth, etc., to one hundred and twenty eighth X-lines are addressed in turn. During each subroutine cycle the incremented value of XA is tested so that the subroutine may be left once the address exceeds the maximum set value XM, initially 127.

If during any one of the subroutine cycles an interrupt signal is detected, microprocessor control is transferred to the Y-selection subroutine.

Y-selection subroutine

FLOW CHART (3) - Figure 3

During execution of this subroutine successive word address signals are sent to the selection input gate to enable controlled and sequential selection of Y-lines in batches of eight. The subroutine is entered whenever the addressed X-line is prssed into contact with any of the Y-lines. The X and Y co-ordinates of the contacted lines are identified and a running sum accumulated in stores XT, YT. The number of contacts made is accumulated in store NC. On entering this subroutine the interrupt flag INT is set to the .TRUE. state, the Y word address YA to an initial value of zero and a subroutine variable YS set to an initial value of zero. The Y-word address YA is then repeated to the address output O_2 of the microprocessor 117, the eighth bit being coded so that the address input gate 121 is closed and the

selection input gate 131 is opened. The first tri-state buffer 135 is then opened and an eight-bit signal admitted to the 8 bit highway 137. This signal is then read at data input I_2 of the microprocessor 117 and stored in store YG.

The data is then examined to determine whether any contact has occurred for the batch read ie whether the word stored in YG is non-zero. If YG is zero, the Y word address YA is incremented and the cycle re-entered, the incremental value of YA being repeated to output 0_2. If YG is non-zero, however, the word YG is examined bit by bit. Bit counter BC is set to zero on entry to a bit examining cycle. BC is incremented each such cycle, until all eight bits of YG have been examined. As the bits of YG are examined in turn, a record is maintained of the number of contacts YG counted per word, the total number of contacts NC per interruption, and Y-co-ordinates for each contact summed to give a total YT for each complete X-scan. After each bit is examined, the word YG is advanced 1 place to the right in a shift register. After all eight bits have been examined, control is transferred to the subroutine cycle and the Y word address YA incremented for selection of the next bathc of Y data. When all sixteen batches of Y data have been examined, the sum XT of the X co-ordinates of the contacts is accumulated and control transferred to the main program. The X-word address is then incremented and the X-scan subroutine continued until all one hundred and twenty eight X-lines have been addressed. If during the X-scan an interrupt has occurred, the interrupt flat INT will have been set to, TRUE, and control passed to the centroid subroutine.

Centroid subroutine

FLOW CHART (4) - Figure 4

The centroid of the contact cluster is now determined from the values XT, YT, the X-co-ordinate and Y-co-ordinate totals respectively, determined during execution of the Y-selection subroutine. Both XT, and YT are divided by the total number of contacts NC detected. The limits of the next X-scan are then calculated. Here it is arranged that sixteen X-conductors on either side of the cluster centroid are scanned during the next scan cycle. Control is now transferred to the main programme and the limited X-scan performed. After the scan, a new centroid is determined and new scan-limits set. This continues until finger pressure is removed from the pad and the pad relaxes. When no further interrupt is detected, control eventually is transferred to the start of of the main programme so that the limits XA = 0, XM = 127 of a full scan may be re-set.

When the display unit is incorporated in an interactive data display system for display of a radar scene, it can be arranged by programming the system computer, that an indicator moves along the display unit screen in response to the movement of an operator's finger on the surface of the touch sensitive switch unit. In this way the indicator may be moved towards one of a number of displayed radar targets. In this case it may also be arranged by appropriate programming that once the operator lifts his finger from the switch unit, label information is displayed on the screen to identify the target nnearest to the most recent indicator position.

It will be understood that the construction of the switch unit is not limited to a conductor configuration defining a cartesian co-ordinate matrix. For example, sets of conductors may be formed in radial and circumferential configuration to define a polar co-ordinate matrix for mapping an arcuate display area.

CLAIMS

1. A touch sensitive switch unit for use in an interactive display system, the unit being constructed as a module and comprising:-
a switch pad having a first set of spaced strip conductors formed upon
a sheet of rigid material,
a second set of spaced strip conductors formed upon a sheet of flexible material and arranged to face the first set of conductors,
a spacer between the two sheets, and,
a pad mounting assembly arranged to hold the sheets about their periphery with the two sets of conductors arranged and separated to provide a matrix of touch addressable contact regions;
address means connected to one set of conductors to supply an address voltage to each conductor in sequence;
detector means, connected to the other set of conductors, constructed to select each conductor in sequence and to detect any change in the voltage state of a selected conductor when contact is made between the selected conductor and an addressed conductor;
control means co-operative with both the address means and the detector means, to synchronise the operation thereof in a scan sequential manner and data supply means co-operative with both the control means and the detector means to provide co-ordinate date identifying the matrix position of any detected contact.

2. A switch unit as claimed in the preceding claim wherein the strip conductors are wide-spaced so that when finger pressure is applied to the flexible sheet only one conductor is urged into contact with another, the spacer being a flexible sheet of insulating material having holes each in register with a corresponding addressable contact region.

3. A switch unit as claimed in claim 2 having a ball bearing assembly comprising: a rigid mask, having an array of retaining holes, and arranged adjacent to the flexible sheet with each retaining hole in register with a corresponding addressable contact region; a plurality of ball bearings, one in each hole; and, overlying the mask and ball bearings, a retaining sheet of flexible material.

4. A switch unit substantially as described with reference to and as shown in the accompanying Figures 8 and 9.

5. A switch unit as claimed in claim 1 wherein the strip conductors are close-spaced so that when finger pressure is applied to the flexible sheet, a cluster of contacts is formed between the two sets of conductors; and, the data supply means is con-

structed to provide co-ordinate data identifying the matrix position of the centroid of the cluster of contacts.

6. A switch unit as claimed in claim 5 including interrupt means co-operative with a plurality of the other set of conductors for providing an interrupt signal when a cluster of contacts is formed, wherein the control means is responsive to the interrupt signal and accordingly in response limits the address and selection scan-sequences to scan a matrix region broadly including the cluster of contacts.

7. A switch unit as claimed in any one of the preceding claims 5 and 6 wherein the spacer is a resilient non-planar frame of insulating material, the spacer being mounted in compression to tension the sheet of flexible material.

8. A switch unit as claimed in any one of the preceding claims 5 and 6 wherein gas between the sheet of rigid material and the sheet of flexible material is maintained at an overpressure to urge the conductors out of contact.

9. A switch unit as claimed in any one of the preceding claims 5 to 8, wherein the control means is a microprocessor.

10. A switch unit as claimed in claim 9 wherein the microprocessor is programmed to follow a programme substantially as described with reference to the flow charts, Figures 1 to 4.

11. A switch unit substantially as described with reference to and as shown in accompanying Figures 8 and 9.

12. An interactive display system comprising:-

a switch unit as claimed in any one of the preceding claims,

a display unit, and,

a computer co-operative with both the switch unit and the display unit; wherein,

the computer is programmed and the system is arranged to perform so that in operation a position indicator is displayed on the display unit at a position determined by touch applied to the switch unit.

13. An interactive display system for the display and identification of radar targets, comprising a switch unit as claimed in any one of the preceding claims 5 to 11;

a display unit; and,

a computer co-operative with both the switch unit and the display unit; wherein

the computer is programmed and the system is arranged to perform so that in operation a position indicator is displayed on the display unit at a position determined by touch applied to the switch unit, and so that when touch is removed from the switch unit, an identifier label is associated with that displayed target nearest to the most recent indicator position.

Printed for Her Majesty's Stationery Office by Croydon Printing Company Limited, Croydon Surrey, 1980.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.